

CLAIMS

What is claimed is:

1. A vehicle drivetrain comprising an engine having a vertical crankshaft, and a lower power take-off drive member comprising a vehicle propulsion transmission below said engine.

2. The vehicle drivetrain according to claim 1 wherein said transmission transmits power along a horizontal plane.

3. The vehicle drivetrain according to claim 2 wherein said transmission comprises at least one member rotating in a horizontal plane below said engine.

4. The vehicle drivetrain according to claim 3 wherein said transmission comprises a constant velocity clutch continuously variable transmission, CVT, comprising a first pulley at the lower end of said vertical crankshaft and driving a belt driving a second pulley, each said pulley rotating in a horizontal plane.

5. A vehicle drivetrain comprising:
an engine having a PTO, power take-off, shaft;
a first transmission below said engine and driven by said PTO shaft;
a second transmission above said first transmission and horizontally adjacent said engine, said second transmission having an input driven by said first transmission, and an output providing vehicle propulsion.

6. The vehicle drivetrain according to claim 5 wherein said PTO shaft extends vertically.

7. The vehicle drivetrain according to claim 5 wherein said output of said second transmission is a horizontal output shaft.

8. The vehicle drivetrain according to claim 5 wherein said input of said second transmission is a vertical input shaft.

9. The vehicle drivetrain according to claim 5 wherein said drivetrain propels the vehicle in a forward direction, said PTO shaft extends vertically, and said input of said second transmission is a vertical input shaft aft of said PTO shaft.

10. The vehicle drivetrain according to claim 9 wherein said output of said second transmission is a horizontal shaft aft of said vertical input shaft.

11. The vehicle drivetrain according to claim 5 wherein:
said PTO shaft extends vertically;
said input of said transmission is a vertical input shaft;
each of said engine and said second transmission are mounted to said

5 first transmission at an upper surface thereof such that said PTO shaft and said input shaft extend vertically and in parallel above said first transmission.

12. The vehicle drivetrain according to claim 11 wherein said output of said second transmission is a horizontal output shaft driven by said vertical input shaft.

13. The vehicle drivetrain according to claim 5 comprising a power transfer device driven by said second transmission to transfer power to propel the vehicle.

14. The vehicle drivetrain according to claim 13 wherein said power transfer device comprises a pair of drive shafts driven in torque balancing counter-rotation, at least one of said drive shafts providing vehicle propulsion.

15. The vehicle drivetrain according to claim 5 wherein:

said PTO shaft extends vertically downwardly;

said second transmission has a downwardly extending vertical input shaft;

5 said first transmission is a constant velocity clutch continuously variable transmission, CVT, having a first pulley driven by said PTO shaft, a second pulley driving said input shaft of said second transmission, and a belt extending around said pulleys and driving said second pulley from said first pulley, said pulleys rotating in a horizontal plane.

16. The vehicle drivetrain according to claim 15 comprising a CVT mounting case housing said first and second pulleys, and wherein said engine and said second transmission are each mounted to said CVT mounting case at
5 respective first and second mounting attachment locations precisely spaced and aligned to provide precise spacing of the centerlines of said PTO shaft and said input shaft of said second transmission and precise alignment of such shafts in parallelism.

17. The vehicle drivetrain according to claim 16 comprising a power transfer device driven by said output of said second transmission to transfer power to propel the vehicle.

18. The vehicle drivetrain according to claim 17 wherein said power transfer device comprises a pair of drive shafts driven in torque balancing counter-rotation, at least one of said drive shafts providing vehicle propulsion.

19. The vehicle drivetrain according to claim 18 wherein said power transfer device comprises a power transfer rotary drive member driven by said output of said second transmission, and comprising a transfer case housing said power transfer rotary drive member, wherein said transfer case is mounted to said second transmission, the first of said drive shafts is mounted to said transfer case in journaled relation, and the second of said drive shafts is mounted to said CVT mounting case in journaled relation.

20. The vehicle drivetrain according to claim 18 wherein:
said drivetrain propels the vehicle forwardly;
said second transmission is aft of said engine;
said output of said second transmission is a horizontally rearwardly extending output shaft;
the first of said drive shafts extends rearwardly;
the second of said drive shafts extends forwardly.

21. The vehicle drivetrain according to claim 17 comprising a transfer case housing said power transfer device and mounted to at least one of said second transmission and said CVT mounting case.

22. The vehicle drivetrain according to claim 21 wherein said power transfer device comprises a power transfer rotary drive member driven by said output of said second transmission, wherein said transfer case is mounted to both said second transmission and said CVT mounting case for enhanced rigidity of the combination of said CVT mounting case and components mounted thereto, namely said engine, said second transmission and said transfer case mounted thereto.

23. The vehicle drivetrain according to claim 16 wherein said CVT mounting case is a sealed case enclosing and protecting said pulleys and said belt against the elements, including water.

24. The vehicle drivetrain according to claim 23 wherein said CVT mounting case has an air inlet port, an air outlet port, and an air circuit duct therein directing air from said air inlet port around said pulleys and said belt for cooling same, and then to said air outlet port.

25. The vehicle drivetrain according to claim 24 wherein said CVT mounting case has a lower clamshell portion having a pair of upstanding walls horizontally spaced from each other and defining a supply passage therebetween extending from said air inlet port and directing cooling air to cool
5 said pulleys and said belt.

26. The vehicle drivetrain according to claim 25 wherein said pulleys are separated by a gap, and said supply passage extends to an area below said gap.

27. The vehicle drivetrain according to claim 26 wherein said lower clamshell portion has a deflector ramp in said supply passage deflecting cooling air upwardly to said gap.

28. The vehicle drivetrain according to claim 26 comprising a transfer duct extending from said lower clamshell portion upwardly into said gap between said pulleys and spaced laterally inwardly of said belt and transferring cooling air from said supply passage.

29. The vehicle drivetrain according to claim 24 wherein said engine has a cooling fan, and comprising an air tube extending between said fan and said air inlet port and supplying cooling air from said fan to said air inlet port.

30. The vehicle drivetrain according to claim 24 wherein said first pulley includes a fan circulating cooling air from said air inlet port to said air outlet port during rotation of said first pulley.

31. The vehicle drivetrain according to claim 25 wherein said lower clamshell portion has an outer peripheral sidewall defining a return passage between said sidewall and said upstanding walls, and wherein said air outlet port is through said outer peripheral sidewall.

32. The vehicle drivetrain according to claim 16 wherein said CVT mounting case further houses a hydraulic pump driven by one of said pulleys.

33. The vehicle drivetrain according to claim 32 wherein:
said drivetrain propels the vehicle forwardly;
said second pulley is aft of said first pulley;
said hydraulic pump is forward of said first pulley and is driven

5 thereby.

34. The vehicle drivetrain according to claim 33 wherein said CVT mounting case has upper and lower clamshell portions enclosing said first and second pulleys and said hydraulic pump, and wherein said hydraulic pump has input and output hydraulic lines extending through said CVT mounting case.

35. The vehicle drivetrain according to claim 16 wherein said CVT mounting case comprises a rigid member mounted to said vehicle and bearing drivetrain stress.

36. The vehicle drivetrain according to claim 16 wherein said CVT mounting case comprises a rigid member mounted to said vehicle and providing both of said first and second mounting attachment locations in a single member.

37. The vehicle drivetrain according to claim 5 wherein:
said PTO shaft extends vertically downwardly;
said second transmission is a 90° gear transmission having a downwardly extending vertical input shaft, and a horizontal output shaft;
5 said first transmission is a constant velocity clutch continuously variable transmission, CVT, having a first pulley driven by said PTO shaft, a second pulley driving said input shaft of said second transmission, and a belt extending around said pulleys and driving said second pulley from said first pulley, said pulleys rotating in a horizontal plane.

38. The vehicle drivetrain according to claim 5 wherein said output of said second transmission drives a differential propelling said vehicle.

39. The vehicle drivetrain according to claim 38 wherein said drivetrain propels said vehicle in a forward direction, and said differential is aft of said second transmission.

40. The vehicle drivetrain according to claim 39 wherein said differential is on a rear axle sprung by a pair of springs.

41. The vehicle drivetrain according to claim 40 comprising a power transfer device driven by said second transmission to drive said differential, wherein said engine, said first and second transmissions and said power transfer device comprise a modular unit, and said springs are leaf springs having forward
5 ends mounted to said modular unit, and rearward ends mounted to said vehicle.

42. The vehicle drivetrain according to claim 41 wherein said modular unit has a forward portion mounted to said vehicle.

43. The vehicle drivetrain according to claim 42 wherein said modular unit is supported by a three-point mounting consisting of said forward ends of said springs and said forward portion of said modular unit.

44. The vehicle drivetrain according to claim 39 wherein said output of said second transmission also drives a second differential propelling said vehicle.

45. The vehicle drivetrain according to claim 44 wherein said second differential is forward of said second transmission.

46. The vehicle drivetrain according to claim 45 comprising a power transfer device driven by said second transmission to drive said first and second differentials, wherein said engine, said first and second transmissions and said power transfer device comprise a modular unit, and wherein said modular unit
5 is between said first and second differentials and supported thereby.

47. The vehicle drivetrain according to claim 5 wherein the vehicle is an ATV, all terrain vehicle.

48. The vehicle drivetrain according to claim 5 wherein said engine has a vertical crankshaft, and said PTO shaft is said vertical crankshaft.

49. The vehicle drivetrain according to claim 48 wherein said crankshaft is exactly vertical.

50. The vehicle drivetrain according to claim 5 wherein said output of said second transmission is a horizontal output shaft, said input of said second transmission is a vertical input shaft, and wherein said output shaft is exactly horizontal, and said input shaft is exactly vertical.

51. The vehicle drivetrain according to claim 15 wherein said plane is exactly horizontal.

52. A modular pre-assembled unit ready for drop-in mounting to a vehicle, and providing a drivetrain for the vehicle, comprising in combination:

- an engine having a PTO, power take-off, shaft;
- a first transmission below said engine and driven by said PTO shaft;
- a second transmission above said first transmission and horizontally adjacent said engine and having an input driven by said first transmission;
- a power transfer device driven by said second transmission to transfer power to propel the vehicle.

53. The modular pre-assembled unit according to claim 52 wherein:

- said PTO shaft extends downwardly and vertically;
- said first transmission is a constant velocity clutch continuously variable transmission, CVT, having a first pulley driven by said PTO shaft, and a second pulley driven by a belt extending around said pulleys, said pulleys rotating in a horizontal plane;

- said second transmission is a 90° gear transmission having a downwardly extending vertical input shaft driven by said second pulley, and a horizontal output shaft;

- said power transfer device comprises a power transfer rotary drive member driven by said output shaft of said second transmission.

54. The modular pre-assembled unit according to claim 53 comprising a CVT mounting case housing said first and second pulleys, wherein said engine and said second transmission are each mounted to said CVT mounting case at respective first and second mounting attachments precisely spaced and
5 aligned to provide precise spacing of the centerlines of said PTO shaft and said input shaft of said second transmission and precise alignment of such shafts in parallelism, and comprising a transfer case housing said power transfer rotary drive member and mounted to at least one of said second transmission and said CVT mounting case.

55. A method for installing drivetrain components in a vehicle, comprising:
providing an engine having a PTO, power take-off, shaft;
providing a first transmission driven by said PTO shaft;
5 providing a second transmission having an input driven by said first transmission, and an output providing vehicle propulsion;
mounting said engine and said second transmission to said first transmission as a self-contained pre-assembled modular unit; and
drop-in mounting said modular unit to the vehicle.

56. The method according to claim 55 comprising providing a power transfer device comprising a power transfer rotary drive member driven by said output of said second transmission, housing said power transfer rotary drive member in a transfer case, and mounting said transfer case to at least one of said
5 first and said second transmissions prior to said drop-in mounting to the vehicle.

57. The method according to claim 55 comprising:
providing said PTO shaft extending vertically downwardly;
providing said second transmission as a 90° gear transmission having a downwardly extending vertical input shaft, and a horizontal output shaft;

5 providing said first transmission as a constant velocity clutch
continuously variable transmission, CVT, having a first pulley driven by said PTO
shaft, a second pulley driving said input shaft of said second transmission, and a
belt extending around said pulleys and driving said second pulley from said first
pulley, said pulleys rotating in a horizontal plane;
10 providing a CVT mounting case housing said first and second
pulleys; and
mounting each of said engine and said second transmission to said
CVT mounting case at respective first and second mounting attachments precisely
spaced and aligned to provide precise spacing of the centerlines of said PTO shaft
15 and said input shaft of said second transmission and precise alignment of said
shafts in parallelism in said pre-assembled modular unit prior to said drop-in
mounting to the vehicle.

58. A method for providing precise spacing and alignment of
rotary shafts in a vehicle drivetrain, comprising:
providing an engine having a PTO, power take-off, shaft;
providing a first transmission comprising a constant velocity clutch
5 continuously variable transmission, CVT, having a first pulley driven by said PTO
shaft, and a second pulley driven by a belt extending around said pulleys;
providing a second transmission having an input shaft driven by said
second pulley, and an output shaft for providing vehicle propulsion;
providing a CVT mounting case housing said first and second
10 pulleys; and
mounting each of said engine and said second transmission to said
CVT mounting case at respective first and second mounting attachments precisely
spaced and aligned to provide precise spacing of the centerlines of said PTO shaft
and said input shaft of said second transmission and precise alignment of such
15 shafts in parallelism.

59. The method according to claim 58 comprising:

providing said second transmission as a 90° gear transmission having said input shaft, and having an output shaft perpendicular to said input shaft;

5 providing a power transfer device comprising a power transfer rotary drive member driven by said output shaft of said second transmission and housed by a transfer case; and

mounting said transfer case to at least one of said CVT mounting case and said second transmission.